

Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to correct grammatical errors.

The claims have been amended to overcome Examiners objections and clarify Applicants disclosed invention.

Support for the amendments and newly drafted claims is found in the original claims and the Specification.

No new matter has been added.

Claim Rejections under 35 USC 112

The claims, including claims 24 have been amended to overcome Examiners rejection under 35 USC 112, second paragraph.

Claim Rejections under 35 USC 102(b)

1. Claims 1, 7, 24, 30 and 31 stand rejected under 35 USC Section 102(b) as being anticipated by Dixit et al. (US 6,355,558).

Dixit et al. disclose a method for filling contacts and via structures with an aluminum alloy (see Abstract). Dixit et al. disclose and teach a multi-layer barrier layer structure including a first wetting layer, TiN, a second wetting layer, and a layer of CVD Al on the second wetting layer, prior to depositing an aluminum alloy as a filling in a PVD process to fill the contacts and vias (see Abstract; see col 3, lines 35-40; col 3, lines 34-67).

Dixit et al. teach a high temperature anneal at about 450° C following deposition of the first wetting layer (col 4, lines 28-37). Dixit et al. also teach an optional high temperature anneal following TiN deposition (col 4, lines 52-62). A plasma treatment is carried out on the second wetting layer (col 5, lines 7-30). A nucleation layer of CVD Al is then deposited (col 5, lines 30-37), taught to be a critical part of the method of Dixit et al. (col 5, lines 37-42). Dixit et al. teach depositing

an aluminum alloy by a PVD process (0.5% Cu) at a temperature of 200 to 500 °C. Dixit et al. teach reflow of the aluminum alloy during PVD deposition (col 5, lines 57-60), preferably at a temperature of 400 °C (col 6, lines 1-5).

Dixit et al. also teach forming an anti-reflective coating on the deposited Al alloy layer (item 52) Figure 2F, prior to forming the completed structure shown in Figure 3 (col 6, lines 21-23).

Thus et al. does not disclose several aspects of Applicants disclosed and claimed invention.

With respect to claim 1,

Nowhere do Dixit et al. disclose:

"c) forming **a** barrier layer to line the via opening;"

"d) **then** forming a layer of AlCu to fill the via opening to form an AlCu via including a portion of said ALCU layer overlying the dielectric layer;"

Nowhere do Dixit et al. disclose:

"forming an AlCu interconnect line from said ALCU portion over the AlCu via, wherein a second barrier layer is optionally formed on said AlCu interconnect line;"

In addition, nowhere do Dixit et al. disclose:

"wherein process steps c) and d) are carried out at a temperature of less than about 400 degrees Centigrade."

Nowhere do Dixit et al. specifically disclose forming an AlCu interconnect line, or suggest that the upper portion of the contact portion (item 50 in Figure 3) is an interconnect line.

With respect to claim 24;

Nowhere do Dixit et al. disclose:

"an AlCu interconnect line disposed on and contiguous with the AlCu via;

wherein the AlCu interconnect line is encapsulated on three

sides with a second barrier layer."

Thus, Dixit et al. is clearly insufficient to anticipate Applicants disclosed and claimed invention.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

"The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Claim Rejections under 35 USC 103(a)

1. Claims 3-4, 13-15, 22-23, and 25-27 stand rejected under 35 USC Section 103(a) as being unpatentable over by Dixit et al., above in view of Zhou et al. (US 6,376,353).

Applicants reiterate the comments made above with respect to Dixit et al.

The fact that Zhou et al. teach a magnetron sputtering process for depositing an AlCu layer in an unrelated structure (top portion of bonding pad) at a temperature of from about 25 to 500 °C does not help Examiner in establishing a prima facie case of obviousness.

There is no apparent motivation for combining the teachings of Zhou et al., who teach forming an AlCu alloy top pad on a Cu bonding pad, with the method of Dixit et al. who teach a method for filling high aspect ratio vias and contacts with an Al alloy including multiple barrier layers and a PVD process including simultaneous reflow. The only motivation for combination appears to be Applicant disclosure.

Moreover, depositing the Al alloy (0.5 % Cu) in the method of Dixit et al. at the lower temperatures of the magnetron sputtering process would make the method of Dixit et al. unsuitable for its intended purpose including a preferred PVD deposition temperature of about 400°C to accomplish simultaneous reflow of the Al alloy.

Nevertheless, even assuming *arguendo* a proper motivation for

combination, such combination does not produce Applicants disclosed and claimed invention.

With respect to claims 14, 22-23, 25 - 27 nowhere to the combined teachings of Dixit et al. and Zhou et al. disclose or suggest Applicants disclosed and claimed invention.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, **and not based on applicant's disclosure.**" *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

"If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the

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claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc.*, 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).

"we do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc.*, 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).

2. Claims 5-6, 28, and 29 stand rejected under 35 USC Section 103(a) as being unpatentable over by Dixit et al., above, in view of Chang et al. (US 6,159,842).

Applicants reiterate the comments made above with respect to Dixit et al.

The fact that Chang et al. teach forming a hybrid FSG layer over AlCu interconnect lines including an FSG liner layer, a porous low-K layer (HSQ) filling the gap between the AlCu lines, and an FSG cap layer on the metal lines and the low-K layer, does

not help Examiner in further establishing a prima facie case of obviousness.

There is no apparent motivation to combine the teachings of Dixit et al. who teaches fill AlCu vias and contacts with a specialized barrier layer and PVD filling process with the method of Chang et al. who teaches etching of a layer of AlCu to form interconnect lines followed by forming a hybrid IMD layer on AlCu interconnect lines. Chang et al. also teach filling overlying vias with tungsten.

Nevertheless, even assuming arguendo, a proper motivation for combination, such combination does not produce Applicants disclosed and claimed invention.

"we do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc.*, 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).

3. Claims 2, 11, 12, 35-37 and 41 stand rejected under 35 USC

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Section 103(a) as being unpatentable over by Dixit et al., above, in view of Matsubara et al. (US 2004/0000719).

Applicants reiterate the comments made above with respect to Dixit et al.

The fact that Matsubara et al. teach a multi-level wiring process including damascene formation (buried conductive portion) where an AlCu alloy in the damascene is formed by depositing a Al film over copper and heat treating to form an AlCu alloy in the damascene portion (see paragraph 0028) does not further help Examiner in establishing a prima facie case of obviousness with respect to Applicants disclosed and claimed invention.

There is not apparent motivation for combining the teachings including the disparate processes of Dixit et al. and Matsubara et al. The modification of either of them to achieve Applicants disclosed and claimed invention would make the structures and methods of both Dixit et al. and Matsubara et al. unsuitable for their intended purpose.

Even assuming *arguendo*, that Matsubara et al. is analogous art and some motivation for combination, which Applicants do not

concede, such combination does not produce Applicants disclosed and claimed invention.

"we do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc.*, 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).

"The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references." *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

3. Claims 16-18 stand rejected under 35 USC Section 103(a) as being unpatentable over by Dixit et al., above, in view of Zhou et al., and further in view of Chang et al.

Applicants reiterate the comments made above with respect to Dixit et al., Zhou et al., and Chang et al.

There is no apparent motivation for combining the teachings of Dixit et al. who teaches fill AlCu vias and contacts with a specialized barrier layer and PVD filling process, with the method of Zhou et al., who teach forming an AlCu alloy top pad on a Cu bonding pad. Moreover, there is no apparent motivation for combining the teachings of Chang et al., who teaches forming an AlCu interconnect line by an unrelated process compared to the via and contact filling process of Dixit et al. including an overlying FSG hybrid IMD layer with either the method of Zhou or Dixit et al. or the bonding pad formation process of Zhou et al.

Nevertheless, even assuming *arguendo* a proper motivation for combination, such combination does not produce Applicants disclosed and claimed invention.

3. Claims 38-40 stand rejected under 35 USC Section 103(a) as being unpatentable over Dixit et al., above, in view of Matsubara et al., and further in view of Chang et al.

Applicants reiterate the comments made above with respect to Dixit et al., Matsubara et al., and Chang et al.

Moreover, there is no apparent motivation for combining the damascene formation process of Matsubara et al. including formation of an AlCu alloy by a heat treatment process with the method of either Chang et al. who teaches an FSG hybrid IMD layer overlying AlCu interconnects formed by an unrelated process, or with Dixit et al., as outlined above.

Nevertheless, even assuming *arguendo* a proper motivation for combination, such combination does not produce Applicants disclosed and claimed invention.

"we do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc.*, 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).

"The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the

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references." *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

DOUBLE PATENTING

Claim 26 has been cancelled to overcome Examiners rejection.

Since the cited references fail to make out a *prima facie* case of anticipation of Applicants independent claims, neither has a *prima facie* case been made out with respect to Applicants dependent claims.

Applicants acknowledge with appreciation Examiners indication of allowable subject matter in claims 8-10, 19-21, 32-34, and 42-44 and have included allowable subject matter as indicated in independent claims 13 and 35.

Applicants have further amended the claims to overcome Examiners rejections and clarify Applicants disclosed and claimed invention.

Based on the foregoing, Applicants respectfully submit that Applicants Claims are now in condition for allowance. Such

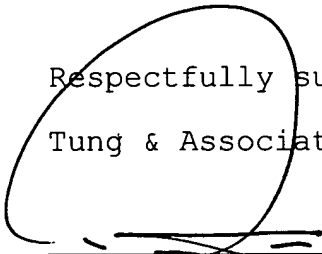
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favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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